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Identifying barriers and opportunities for adaptation planning of urban transport infrastructure: a case study of Bogotá, Colombia

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1 INTRODUCTION & SCOPE OF WORK

Cities need to be at the forefront of efforts against climate change. Urban settlements occupy a central position in the adaptation agenda mainly because cities are particularly threatened by climate change due to different factors, including their heavy reliance on interconnected infrastructure; high population densities (including large number of vulnerable communities); the concentration of different cultural and economic assets; and because urbanization worldwide will continue to define the 21st century (Carter et al., 2015).

Transport infrastructure is vital for the efficient functioning of urban settlements. Planning the adaptation of transport systems to climate change is, therefore, crucial for the success of cities in the future. Climate adaptation planning is a complex process that can be defined as "social and decision processes that facilitate the implementation of interventions to reduce vulnerability and/or take advantage of potential opportunities associated with climate variability and change" (Preston, Westaway, & Yuen, 2011, p. 413). Different challenges cause adaptation planning to be a difficult task as there is always the risk of succumbing to maladaptation pathways (Adger & Barnett, 2009; Wise et al., 2014). Nevertheless, uncertainty should not be used as a justification for inaction (i.e., the precautionary principle).

Challenges to adaptation planning are commonly defined in the academic literature as 'barriers to adaptation' and they can emerge in any of the processes of adaption planning, hindering the ability of decision-makers to take action. Decision-makers, such as transport planners, that become aware of these barriers have the potential to transform them into opportunities to make adaptation planning processes better and more effective. This paper shows how barriers and opportunities for effective adaptation planning of urban transport infrastructure can be identified from a socio-technical perspective by using an analytical framework developed by Lehmann et al. (2015). This paper aims to demonstrate its utility for urban transport planners using evidence collected as part of an in-depth case study of Bogotá, Colombia.

2 METHODOLOGY

This paper applies an analytical framework developed by Lehmann et al. (2015) to identify barriers and opportunities for effective adaptation planning; shown in Fig. 1. This framework was developed to understand what hinders or allows decision-makers in cities to take action regarding adaptation to climate change. This paper demonstrates how Lehmann et al.'s analytical framework can be used in the specific context of adaptation planning of urban transport infrastructure.

This analytical framework was chosen for two reasons. First, unlike other available frameworks, Lehmann et al.'s permits the identification of barriers and opportunities for effective adaptation planning, and at the same time, it helps with the recognition of different underlying factors that cause them to emerge. This allows for a deeper analysis of adaptation planning processes and an understanding of how to possibly improve them. Second, Lehmann et al. have demonstrated that their framework has applicability across different development

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contexts, thus, making it attractive since it can be employed by practitioners in any city regardless of its development status.

As shown by Fig. 1, barriers and opportunities for urban adaptation planning can be associated with one of the three categories: 1) information quality and availability, 2) resources available, and, 3) incentives on which decision-makers have to act. Each of these categories is influenced by underlying factors related to: 1) actor-specific characteristics, 2) the institutional environment, and, 3) the natural and socio-economic environment.

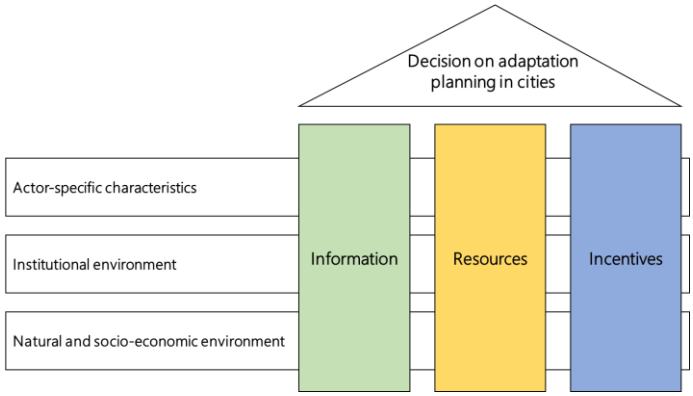

Figure 1. *Variables influencing decisions on adaptation planning in cities. Adapted from Lehmann et al.* (2015).

This research gathered evidence of barriers and opportunities related to the adaptation planning of urban transport infrastructure in Bogotá, Colombia through forty semi-structured interviews and was complemented by an analysis of relevant local policy documents and technical reports. The interviews and document analysis were conducted as part of an in-depth single-case study of the decision-making processes for the development and maintenance of transport infrastructure in Bogotá, Colombia and the level of incorporation of considerations of climate change adaptation in these processes. Participants and the documents used for the analysis were selected following non-random sampling methods.

The forty semi-structured interviews were conducted with forty-eight local professionals in transport planning, urban planning, climate change, risk management and politics. Participants were directly approached based on their roles in key public and private organisations of the transport, environmental and disaster risk management sectors of Bogotá (non-random sampling). This involved roles in risk management, climate change or asset management. This process reached those who have extensive experience in the decision-making processes for the development and maintenance of transport infrastructure in Bogotá and obtained good coverage of those in key decision-making roles. Due to the nature of this qualitative research method, it was more important to reach those persons that have special access to the phenomenon studied (i.e., experts), than achieving a minimum number of interviews as it can be argued that their unique experience is more valuable than that of those who have no influence or limited direct contact with the phenomenon studied.

Both the transcriptions of the semi-structured interviews and the analysed documents were coded using the code ‘barriers to adaptation’ and three sub-codes associated with the categories of barriers and opportunities of Lehmann et al.’s (2015) framework (i.e., ‘information’, ‘resources’ and ‘incentives’). All statements made by participants or found in the analysed documents related to existing problems, obstacles for transport planning, adaptation planning in the city or related to opportunities to improve these processes, were coded using the appropriate sub-code. All the references found in the transcriptions and documents analysed in the coding process were used as the evidence for the analysis presented in this paper.

3 RESEARCH OUTCOMES

The application of the analytical framework identified barriers in all three categories (information, resources and incentives) for the effective adaptation of transport infrastructure in the city.

Barriers and opportunities related to information quality and availability were identified as the most influential to the effective planning of adaptation of road infrastructure to climate change in Bogotá. The most significant barrier in this category is the lack of good understanding of the concept of adaptation amongst transport

planners and other decision makers in the city. Understanding this concept means comprehending the required and available adaptation actions, how to measure their effectiveness, the costs of adaptation actions, and the benefits of climate change adaptation. Different evidence supports the presence of this barrier for effective adaptation planning in the city. For example, the group of professionals from the District Mobility Secretary of Bogotá in charge of the development of the adaptation strategy for the city's transport sector acknowledged in their interviews that the task has been very challenging as they still perceive adaptation to climate change as a very ethereal or abstract concept and do not yet fully understand what it implies in practice.

The main cause behind this information barrier is how adaptation has been framed conceptually in the city's policy documents and institutional arrangements. Due to the influence of Colombia's national climate change policies, climate change action in Bogotá is conceptually associated with risk management and is institutionally a responsibility of the environmental sector. This has allowed for the concept of adaptation to be hidden behind other concepts in the city's policy documents such as risk management, eco-urbanism and environmental management, in what is called by some authors 'adaptation by stealth' (Di Giulio, Bedran-Martins, Vasconcellos, Ribeiro, & Lemos, 2017; Rasmussen, Kirchhoff, & Lemos, 2017). This results in an unclear definition of what adaptation actually means in practice and creates confusion among the different stakeholders of the city. After being asked what kind of adaptation actions their organisations have been performing or are planning to perform, interviewees answered by mentioning actions from risk management, mitigation, environmental management or green construction as if they were adaptation actions. Giving any example of environmental actions from this metaphorical 'environmental portfolio' to demonstrate that adaptation actions are being performed seems to be perceived as logical for a public servant and also has the potential to mask any non-performance of actions in their office. Additionally, the city has decided to focus on ecosystem-based adaptation which creates other issues with framing. This approach to adaptation effectively generates tunnel vision of the concept of adaptation for professionals in the city. Ecosystem-based adaptation considers only the betterment of drainage systems, green infrastructure and the protection of crucial ecological systems that provide ecological services to the city, as adaptation actions. This creates the illusion that other elements of the city, for example, road infrastructure, do not need to be adapted to climate change.

This shows the crucial importance that an appropriate conceptual framing of the concept of adaptation has for the effective planning of adaptation to climate change in a city like Bogotá. Not only city authorities, but also international organisations such as the United Nations Environmental Programme, should be more careful about framing their adaptation actions following just one approach like ecosystem-based adaptation as this can hinder the actions of different decision-makers such as transport planners and other professionals by establishing artificially the limits of adaptation measures to a small set of available options. Other approaches like infrastructure-based adaptation or community-based adaptation should also be part of the available portfolio for adaptation practitioners in all sectors as to avoid barriers and create opportunities for effective adaptation planning as the ones identified in this paper.

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